

CLAIMS

1. A polishing state monitoring apparatus comprising:
- a light source;
 - 5 a light-emitting unit disposed in a polishing table having a polishing surface, for applying light from said light source to a surface, being polished, of a workpiece;
 - a light-receiving unit disposed in said polishing table, for receiving reflected light from said surface of said
 - 10 workpiece;
 - a spectroscopy unit for dividing the reflected light received by said light-receiving unit into a plurality of light rays having respective wavelengths;
 - light-receiving elements for detecting the light rays
 - 15 divided by said spectroscopy unit, and accumulating the detected light rays as electrical information;
 - a spectral data generator for reading the electrical information accumulated by said light-receiving elements and generating spectral data of the reflected light;
 - 20 a control unit for controlling said light-receiving elements to perform a sampling process at a predetermined timing in synchronism with rotation of said polishing table; and
 - a processor for calculating a predetermined characteristic value on said surface of said workpiece based
 - 25 on the spectral data generated by said spectral data generator.

2. A polishing state monitoring apparatus according to claim 1, wherein said control unit controls the timing of the sampling process performed by said light-receiving elements
- 30 so that a sampling point is located on a line interconnecting the center of said polishing table and the center of said workpiece.

3. A polishing state monitoring apparatus according to claim 2, wherein said light-emitting unit and said light-receiving unit pass across the center of said workpiece.

5 4. A polishing state monitoring apparatus according to any one of claims 1 through 3, wherein said control unit is capable of adjusting the sampling period of the sampling process performed by said light-receiving elements based on a rotational speed of said polishing table.

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5. A polishing state monitoring apparatus comprising:
a light source;

a light-emitting unit disposed in a polishing table having a polishing surface, for applying light from said light
15 source to a surface, being polished, of a workpiece;

a light-receiving unit disposed in said polishing table, for receiving reflected light from said surface of said workpiece;

a spectroscopy unit for dividing the reflected light
20 received by said light-receiving unit into a plurality of light rays having respective wavelengths;

light-receiving elements for detecting the light rays divided by said spectroscopy unit, and accumulating the detected light rays as electrical information;

25 a spectral data generator for reading the electrical information accumulated by said light-receiving elements and generating spectral data of the reflected light;

a control unit for controlling said light-receiving elements to perform a sampling process at a predetermined timing
30 in synchronism with rotation of said polishing table; and

a processor for calculating a predetermined characteristic value on said surface of said workpiece according to a calculation including a multiplication which multiplies

wavelength components of the spectral data generated by said spectral data generator by a predetermined weighting coefficient.

5 6. A polishing state monitoring apparatus according to claim 5, wherein said characteristic value comprises a chromaticity coordinate value converted from said spectral data.

10 7. A polishing state monitoring apparatus according to any one of claims 1 through 6, wherein said light source emits light having a wavelength band.

15 8. A polishing state monitoring apparatus according to any one of claims 1 through 7, wherein said light source comprises a pulsed light source.

20 9. A polishing state monitoring apparatus according to any one of claims 1 through 8, wherein said light source comprises a continuous light source which is continuously turned on at least while said light-receiving elements are detecting the reflected light from said surface of said workpiece.

25 10. A polishing apparatus comprising:
a top ring for holding a workpiece;
a polishing table having a polishing surface which
is brought in sliding contact with said workpiece;
a polishing state monitoring apparatus according to
any one of claims 1 through 9; and
30 a light transmission unit mounted on said polishing
table for transmitting therethrough the light applied from said
light-emitting unit of said polishing state monitoring apparatus
and the reflected light from said surface of said workpiece.

11. A method of polishing a film formed on a workpiece, comprising:

applying light from a light source to a surface, being polished, of a workpiece;

5 detecting reflected light from said surface of said workpiece;

dividing the detected light and generating spectral data thereof;

10 multiplying said spectral data by a predetermined weight function and integrating the product to generate a scalar value;

calculating a characteristic value of said surface of said workpiece using said scalar value; and

15 monitoring the progress of polishing of said surface of said workpiece using said characteristic value.

12. A method according to claim 11, wherein a characteristic point of time variation of said characteristic value is detected, and a polishing process is stopped or a
20 polishing condition is changed when a predetermined time has elapsed after detection of the characteristic point.

13. A method according to claim 11 or 12, wherein said weight function is adjusted using the time variation of
25 said characteristic value.

14. A method according to claim 13, wherein said weight function is adjusted by moving said weight function along a wavelength axis.

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15. A method according to any one of claims 11 through 13, wherein said film comprises a metal film.

16. A method according to any one of claims 11 through 14, wherein said film comprises an oxide film.

17. A method according to any one of claims 11 through 14 and 16, further comprising:

multiplying said spectral data by a desired second weight function different from said weight function and integrating the product to generate a second scalar value;

calculating a second characteristic value of said surface of said workpiece using said second scalar value; and monitoring the progress of polishing of said surface of said workpiece using said characteristic value and said second characteristic value.

18. An apparatus for polishing a film formed on a workpiece, comprising:

a light source for applying light to a surface, being polished, of a workpiece;

a light-receiving unit for receiving reflected light from said surface of said workpiece;

a spectroscope unit for dividing the reflected light received by said light-receiving unit;

a spectral data generator for generating spectral data from the divided light; and

a processor for multiplying said spectral data by a desired weight function and integrating the product to generate a scalar value, and calculating a characteristic value of said surface of said workpiece using said scalar value.

19. An apparatus according to claim 18, further comprising:

an input unit for setting said weight function; and a display unit for monitoring said characteristic value.

20. An apparatus according to claim 18, further comprising:

- a polishing surface;
- a top ring for holding said workpiece and pressing
- 5 said surface of said workpiece against said polishing surface;
- a detector for detecting a characteristic point of time variation of said characteristic value; and
- a control unit for stopping a polishing process or changing a polishing condition after elapse of a predetermined
- 10 time from detection of said characteristic point.

21. An apparatus according to any one of claims 18 through 20, wherein said film comprises a metal film.

15 22. An apparatus according to any one of claims 18 through 21, wherein said film comprises an oxide film.

23. An apparatus according to any one of claims 18 through 22, wherein said processor multiplies said spectral data

20 by a desired second weight function different from said weight function and integrates the product to generate a second scalar value, and calculates a second characteristic value of said surface of said workpiece using said second scalar value.

25 24. A polishing state monitoring apparatus comprising:

- a light source for applying light to a surface, being polished, of a workpiece;
- a light-receiving unit for receiving reflected light
- 30 from said surface of said workpiece;
- a spectroscopy unit for dividing the reflected light received by said light-receiving unit;
- a spectral data generator for generating spectral data from the divided light; and

a processor for multiplying said spectral data by a desired weight function and integrating the product to generate a scalar value, and calculating a characteristic value of said surface of said workpiece using said scalar value.

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25. An apparatus according to claim 24, further comprising an input unit for setting said weight function and a display unit for monitoring said characteristic value.